REVIEW

by competition for the academic position of associate professor

in a professional direction
4.5. Mathematics (Ordinary Differential Equations, Hamiltonian systems
and applications),

for the needs of Sofia University, St. Kliment Ohridski",

Faculty of Mathematics and Informatics (FMI),

announced in SG no. 56 of 30.06.2023

The review was prepared by:
Associate Professor, Doctor Angel Ivanov Zhivkov – Sofia University, Faculty of Mathematics and Informatics, "Differential Equations"department, in my capacity as a member of the scientific jury for the competition 4.5. Mathematics (Ordinary Differential Equations, Hamiltonian systems and applications) according to Order No. RD 38-520/29.08.2023 of the Rector of Sofia University.

They submitted documents for participation in the announced competition the following candidates:
1. **Georgi Ivanov Georgiev**, chief assistant doctor FMI, SU, "Differential Equations"department
2. **Svetlin Georgiev Georgiev**, chief assistant, Ph.D FMI, SU, "Differential Equations"department

The first of the two candidates, Georgi Ivanov Georgiev, withdrew his candidacy because in the meantime won a previous competition for an associate professorship in the same department "Differential equations FMI, SU.

The retirement of already associate professor Georgi Ivanov Georgiev was registered with a letter from the Rector of SU dated 15.09.2023. Therefore, I will only review the associate professor candidate Svetlin Georgiev Georgiev.

About Svetlin Georgiev Georgiev

The documents presented in the competition from the candidate corresponds to the requirements of ZARASRB, PPZRASRB and the Regulations for the

terms and conditions for the acquisition of scientific degrees and occupying academic positions at the University of "St. Clement Ohridski" (PURPNSZADSU).

Scientific papers

To participate in the competition, the candidate submitted two works.

The joint article with T. Xiang

T. Xiang and S. Georgiev. Noncompact-type Krasnoselskii fixed point theorems and their applications. Mathematical Methods in the Applied Sciences, Vol. 39, Issue 4, 2016, pp. 833-863

was published in a journal with a high Impact Factor in which Svetlin Georgiev is a member of the collegium.

The article offers methods for solving different types perturbation equations arising in applied sciences. These methods are based on generalizations of abstract theorems about existence of fixed points x of operator equations $Tx + Sx = x$ where x belongs to a convex closed subset of a Banach space, and the operators S and T are of different type. 8 such variants of theorems are specified.

Applications of the above results follow next. The equation

$$\left[v_3 \frac{\partial}{\partial x} + \sigma(x, v) + \lambda \right] \psi(x, v) = \int_{\mathbb{S}^2} r\left(x, r, r', \psi(x, v') \right) dv'$$

defines the asymptotics of the energy distribution $\psi(x, v)$, depending on the variables $x \in [0, 1]$ and $v = (v_1, v_2, v_3) \in \mathbb{S}^2$, the functions $\sigma, \lambda \in \mathbb{C}$ and r are known. It characterizes possible energy leakage along channel boundaries ($\psi(0, v)_{|v \in \mathbb{S}^2}$ is the input, and $\psi(1, v)_{|v \in \mathbb{S}^2}$ is the outgoing boundary).

A theorem was formulated and proved that if 4 conditions hold, then the above equation has a solution and it is unique.

In the next paragraph, Darboux's first quadrant task is discussed

$$u_{xy}(x, y) = \lambda u(x, y) + \mu g(x, y, u(x, y)), \qquad x \geq 0, \ y \geq 0,$$
$$u(x, 0) = \phi(x), \quad u(0, y) = \psi(y),$$

where λ and μ are non-negative constants, ϕ and ψ are C^1–functions and g is continuous.

Conditions for λ, μ, and g are found, where the above Darboux problem has a global C^1– solution u, the derivative u_{xy} exists and is continuous. The proof of this theorem is broken down into 12 lemmas and two propositions.

Next, the author considers a class of differential equations

$$\Delta u(n) = a(n)u(n) + \lambda b(n)f(u(n - \tau(n))) + g(n)\,, \quad n \in \mathbb{Z}\,,$$

where $\Delta u(n) = u(n+1) - u(n)$, a, b, τ and g are ω–periodic functions, and λ is a constant.

Different types of conditions are indicated for a, b, τ, g and λ, where we can guarantee the existence of a solution $u = u(n)$, as well as to estimate the growth of these solutions.

Finally, a theorem on the existence and uniqueness of is proved the solution of the perturbed Volterra equation

$$u(t) = \int_a^t k(t,s)u(s)ds + f(t, u(t))\,, \ \ u(t) = \int_a^t k(t,s)u(s)ds + f(t, u(t))\,, \quad t \in [a,b]$$

for special values of the kernel k and the perturbation f .

The second scientific work presented by S. Georgiev is the standalone book (402 pages)

S. Georgiev. *Integral Equations on Time Scales*, Atlantis Press, 2016.

According to WikipediaA, "In mathematics: Time-scale calculus, the unification of the theory of difference equations with differential equations."
S. Georgiev's book is a supplement to the foundational work

M. Bocher, A. Peterson, *Dynamic Equations on Time Scales: an Introduction with Applications* (Birkhauser, Boston, 2003).

Over 50 new theorems necessary for the practical calculations of various integrals equations on time scales and the reduction of dynamic to integral equations. Of course, the proof of most of these theorems is relatively easy.
Hundreds of concrete examples of
– Volterra's integral equations,
– integro-differential equations,
– equations of the Fredholm type,
– Hilbert-Schmidt integral equations with symmetric kernels,
– Laplace transform,
– solutions in the form of lines ("series solution"),
– nonlinear integral equations on time scales.

The theoretical part of the book, plus the detailed calculations in it, in my opinion, make it a good textbook on "Time-scale calculus".

Teaching and educational-pedagogical activity. Svetlin Georgiev has an excellent list of courses led by him.

Mandatory – in FMI or BF of SU:

– "Differential equations and applications" special, "Informatics"
– "Equations of mathematical physics special.„Applied math",
– "Partial differential equations", special, "Mathematics",
– "Mathematics and informatics special "Biology".
– "Mathematical analysis of functions of many variables spec. "Engineering Physics", "Medical Physics".

Elective courses – at FMI SU:

– "Wave images",
– "Integral equations",
– "Tensor calculus",
– "Clifford's Analysis of Differential Equations",
– "Theory of semigroups and applications",
– "Introduction to the theory of discrete dynamical systems and chaos",
– "Dynamic computation on time scales".

Most of the elective courses have been written and issued (in foreign publishing houses) relevant textbooks, monographs or books.

My assessment of the candidate's teaching-pedagogical activity is very good.

I have no critical notes or recommendations on the science and the teaching activity of the candidate.

Personal impressions of the candidate. I have known Svetlin Georgiev since 2001, when I was a reviewer of his doctoral dissertation. Since then he has made an unexpectedly successful for me leap in his science development.

Conclusion of the application. After getting acquainted with the materials presented in the competition and scientific works and based on the analysis of their significance and scientific-applied contributions contained in them, I confirm, that they meet the requirements of ZRASRB, The regulations for its application and the relevant Regulations of the University of St. Kliment Ohridski" to borrow from the candidate for the academic position of associate professor in the scientific field and professional direction of the competition. In particular, the applicant satisfies the minimum national requirements

requirements in the professional direction and has not been established plagiarism in the scientific works submitted for the competition.

I give my positive assessment to the candidature of Svetlin Georgiev.

OVERALL CONCLUSION

The volume of Svetlin Georgiev's scientific output is extraordinary – a total of 49 articles, 40 participations in conferences abroad, 16 books, incl. four of them published by Springer or Birkhauser.

The teaching activity of Svetlin Georgiev is diverse, there are actually textbooks written on most of what he read elective courses.

Based on the above, **recommend to the scientific jury to choose Svetlin Georgiev Georgiev as associate professor.**

Sofia, October 26, 2023   Prepared the review:

(Assoc. Dr. Angel Zhivkov)